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International connectivity and the location of multinational enterprises' knowledge-intensive activities: Evidence from US metropolitan areas

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Abstract

Research summary: International connectivity is a multidimensional construct that plays a pivotal role in attracting the activities of multinational enterprises (MNEs) by facilitating intra-firm coordination and access to external resources. We conceptualize how the different dimensions of international connectivity determine the location of MNEs' knowledge-intensive activities, with a focus on Research and Development (R&D) laboratories and Headquarter units (HQ). By analyzing 3,101 greenfield investments of MNEs in US Metropolitan Statistical Areas, we show that R&D activities are attracted toward areas connected to the rest of the world by international networks of inventors. Moreover, we find that infrastructures which ensure the mobility of people across borders, and greater connectivity through advanced producer services are key location factors for HQ activities.

Managerial summary: The choice of where multinational enterprises (MNEs) locate their knowledge-intensive activities is a crucial decision for managers, with important implications for policymakers. It has become increasingly clear that MNEs value the extent to which individual locations are connected globally.

We study this international connectivity and highlight that it is a multidimensional construct spanning knowledge, infrastructure, and producer service networks. This study shows that not every dimension of international connectivity is equally important for MNEs in locating different knowledge-intensive activities. Research and Development laboratories are attracted toward areas connected worldwide by international networks of inventors. Moreover, headquarter units are more likely to be established in locations featuring greater connectivity through the mobility of people and advanced producer services.

KEYWORDS

connectivity, headquarters, knowledge-intensive activities, location choice, multinational enterprises, R&D, United States

1 | INTRODUCTION

Multinational enterprises' (MNEs) location choices continue to attract the attention of scholars, managers, and policymakers (for recent literature reviews see Kim & Aguilera, 2016; Nielsen, Asmussen, & Weatherall, 2017). Falling spatial transaction costs have facilitated the fine slicing of the value chain, leading MNEs to locate individual activities in locations distributed worldwide (Mudambi, 2008) in search of locational features that best fit these activities' specific strategic objectives and functional responsibilities. Simultaneously, locations at different subnational levels have become increasingly active in attracting the activities of foreign MNEs (e.g., Beugelsdijk & Mudambi, 2013; Goerzen, Asmussen, & Nielsen, 2013), endeavoring to leverage their distinctive resource endowments to match specific firm-level requirements. Thus, when explicitly factoring in the motives behind MNE location choices (e.g., Driffield & Love, 2007) and for understanding how they interact with locational characteristics (e.g., Beugelsdijk & Mudambi, 2013), the subnational level and, notably, the city level should be considered, in addition to a country level analysis (Asmussen, Nielsen, Weatherall, & Lyngemark, 2019; Belderbos et al., 2017a, 2020; Goerzen et al., 2013; Mudambi et al., 2018).

Among the different spatial features that have gained importance as drivers of MNE location choices, scholars have recently underscored the key role of *international connectivity* (Asmussen et al., 2019; Belderbos et al., 2017a; Goerzen et al., 2013; Ma, Delios, & Lau, 2013). International connectivity especially impacts MNE activity, because these firms are required to orchestrate a geographically fragmented network of cross-border activities, which need to be efficiently coordinated and connected across space. Connectivity has been defined "as the ease and intensity with which people, goods, capital, and knowledge flow across space" (Beaverstock, Doel, Hubbard, & Taylor, 2002; Belderbos et al., 2017a, p. 1275). Therefore, it is—by its very nature—a multidimensional construct, and each location features a different mix of international connectivity components. While such components may be reasonably intertwined, they have different characteristics, which are likely to attract specific MNE activities.

The literature has widely analyzed the importance of connectivity for the location decisions of manufacturing, logistics and retail firms (Asmussen et al., 2019; Basile, Benfratello, & Castellani, 2013; Lavoratori, Mariotti, & Piscitello, 2020; Love & Roper, 2001), often emphasizing the key role played by infrastructural connections in the "physical goods value chain" of MNEs (Asmussen et al., 2019, p. 356). However, this stream of studies has devoted less attention to the role of connectivity in the location of knowledge-intensive activities, such as those that are conducted in MNEs' Research and Development (R&D) laboratories and Headquarter (HQs) units. This is surprising, given that knowledge-intensive activities are often the primary source of a firm's competitive advantage and MNEs may benefit from the opportunity to locate them where the best possible conditions are offered for their implementation.

Against this background, this study unpacks the complex concept of international connectivity into (a) inventor connectivity, (b) producer services connectivity, and (c) infrastructural connectivity to study how these dimensions determine the location of MNEs' knowledge-intensive activities, that is, R&D and HQ. Combining economic geography and international business literatures, we adopt a fine-grained level of analysis of the activities of MNEs abroad and the host locations, to explain how MNEs choose their optimal locations. Specifically, our empirical analysis relies on data on greenfield investment projects in HQ and R&D activities made over the period 2009–2014 by foreign MNEs in the US Metropolitan Statistical Areas (MSA). This approach enables us to advance the findings of previous studies, that mainly analyzed FDI stocks (e.g., Asmussen et al., 2019), by documenting the locational implications of the motives behind MNEs' FDI in R&D and HQ.[1]

Our results reveal that inventor connectivity is an important factor in the location decision of R&D activities, whereas producer services and infrastructural connectivity enable better mobility of people, thereby spurring the location of HQ activities. Conducted for comparability, additional analyses on less knowledge-intensive activities reveal that the latter type of connectivity is also important in attracting sales and marketing activities of MNEs. Further, infrastructures that facilitate the movement of goods, attract production and logistic activities.

Our paper mainly offers two contributions to extant literature. First, in embracing the approach of recent studies that have highlighted the importance of unpacking the concept of international connectivity, we contribute to the enrichment of knowledge of this complex construct. Expressly, as in Asmussen et al. (2019), we recognize that international connectivity results from physical infrastructures for the international mobility of goods and from producer service firms; however, we also integrate these dimensions with a focus on the role of *inventors* in creating knowledge connections across locations and on the importance of infrastructures for the *international mobility of people*. These two aspects have been previously considered by Belderbos et al. (2017a), but—unlike them—we choose not to consolidate these dimensions into a composite indicator of international connectivity. Instead, we single out the role of each dimension of connectivity in attracting specific MNE knowledge-intensive activities. In doing so, we recognize that connectivity is a multidimensional construct, and its different dimensions deserve to be accounted for individually and comprehensively to appreciate their role in firm strategic behavior.

Second, we focus on the location of different knowledge-intensive activities in MNEs. We submit that these activities are mainly concentrated in R&D departments—where new knowledge incorporated in innovative product and process resides, and in HQ—where knowledge on the firm's coordination, control, and strategic direction is located. These two activities used to be centralized at the parent company level within MNEs, but over the past decades have witnessed a substantial process of decentralization and internationalization (Benito, Lunnan, & Tomassen, 2011;

Papanastassiou, Pearce, & Zanfei, 2020). The choice of where to locate R&D laboratories and divisional/country/regional headquarters abroad has been studied in recent years (e.g., Bel & Fageda, 2008; Belderbos et al., 2014, 2017a, 2017b; Castellani & Lavoratori, 2020; Cantwell & Mudambi, 2000; Crescenzi, Pietrobelli, & Rabellotti, 2014; Ma, Delios, & Lau, 2013), but mainly individually and without fully exploring the extent to which different aspects of connectivity affect these different activities. While both R&D and HQ activities involve a substantial degree of knowledge intensity, they are quite different from each other, as the former requires knowledge of technology and innovation processes, and the latter involves managerial knowledge on how to orchestrate, control and provide strategic direction to the MNE action. This comparison allows us to provide a richer picture of the role of international connectivity in MNEs' location decisions of knowledge-intensive activities, and to improve our understanding of the motives behind MNEs' FDI in R&D and HQ.

2 | THEORETICAL FRAMEWORK

2.1 | The internationalization of MNE knowledge-intensive activities

MNEs are often conceptualized as complex organizations whose existence and long-term performance arise from the ownership of some unique combination of knowledge and competencies that are nonlocation-bound and thus, can be transferred across the firm's geographically distributed network (Rugman & Verbeke, 2001). In other words, an MNE's success and survival are inherently tied to its knowledge, and to its ability to make such knowledge available within the internal network of foreign subsidiaries, thereby ensuring the effective orchestration of its far-flung units. This requires the MNE to conduct multiple knowledge-intensive activities, ranging from the development of technological knowledge, largely undertaken in R&D departments, to the coordination, control, and strategic direction of the firm, which is usually concentrated in HQ units.

Originally centralized in MNEs' home countries, over the past decades, both R&D and HQ activities have experienced significant degrees of decentralization and internationalization (Benito et al., 2011; Laamanen, Simula, & Torstila, 2012; Papanastassiou et al., 2020). As an example, international business literature suggests that MNEs internationalize their R&D to tap into new pockets of expertise that allow them to augment their specialized technologies (e.g., Cantwell & Mudambi, 2005; Kuemmerle, 1999). Similarly, MNEs establish their HQs abroad to ensure that their value-creation role can be performed more effectively, thus overcoming the challenges that arise from the growing separation between the home-country and their foreign activities (Benito et al., 2011). While this literature offers insights into the drivers of FDI in R&D and HQ units, our understanding of the locational factors that attract such types of activities remains incomplete. Specifically, we still lack a systematic analysis of how a location's endowment in terms of connections to the rest of the world attracts MNE activities that feature a high intensity of knowledge including—technological knowledge for R&D activities, and organizational and strategic knowledge for HQ units.

2.2 | Subnational heterogeneity and international connectivity

While economic geography literature depicts locations in the process of actively attracting homogeneous firms willing to benefit from agglomeration economies, the international business perspective conceives firms as the engine of global activity that design and manage their organizational boundaries across borders to exploit firm-specific advantages. Cano-Kollmann, Cantwell, Hannigan, Mudambi, and Song (2016) merge these perspectives to forward an overarching theoretical framework in which mobile firms and immobile locations co-evolve and shape one another as they dynamically interact. To study MNE location choices, which are in fact the first point of contact between mobile firms and immobile locations, it is useful to follow this approach and combine studies on MNEs' strategies and decisions regarding the spatial distribution of economic activity (e.g., Alcácer, 2006; Alcácer & Delgado, 2016) and perspectives on the relevance of subnational heterogeneity (e.g., Beugelsdijk, McCann, & Mudambi, 2010; Crescenzi et al., 2014; Iammarino & McCann, 2013; Mudambi et al., 2018).

Research on MNE location choices has been recognizing that "subnational spatial heterogeneity is often the characteristic that drives firm strategy as MNEs decide to locate in particular agglomerations and not at random locations within a country" (Beugelsdijk & Mudambi, 2013, p. 413). Recently, subnational and city regions, in particular, have been in the spotlight not only for the localized assets that companies may find within their spatial boundaries, but also because they grant access to international networks that channel the flow of relevant resources. In other words, when it comes to attracting MNEs' FDI, the resources that a location enables access to via international networks might be as important as the resources immediately available within the location (Bathelt, Malmberg, & Maskell, 2004; Belderbos et al., 2017a; Cano-Kollmann et al., 2016).

2.3 | The different dimensions of connectivity

To analyze the role of international linkages in the location choices of different MNE activities, scholars originally focused on global cities and their features (Goerzen et al., 2013; Ma, Delios, & Lau, 2013), and have only more recently tried to explicitly capture the construct of *international connectivity* (Asmussen et al., 2019; Belderbos et al., 2017a). The importance of this locational feature has been emphasized by economic geography perspectives (e.g., Bathelt et al., 2004) suggesting that global links connecting nodal places favor economic prosperity as they sustain contacts to "the flows of knowledge, capital, people and goods that circulate in the world" (Beaverstock et al., 2002, p. 114). Connectivity has thus been depicted as a multidimensional concept, because it encompasses ties that may channel different resources. As described by Belderbos et al. (2017a), three approaches have been adopted to study connectivity: (a) the knowledge-centered approach (e.g., Cano-Kollmann et al., 2016; Lorenzen & Mudambi, 2013), (b) the corporate organization approach (e.g., Derudder, Taylor, Witlox, & Catalano, 2003; Taylor, 2001), and (c) the infrastructure approach (Mahutga, Ma, Smith, & Timberlake, 2010).

First, according to the knowledge-centered approach, places grow and remain competitive not only due to the local knowledge that is developed within their territorial boundaries, but also due to the connection with distant sources of ideas, information, and specialized knowledge (Asheim & Coenen, 2006) that contribute to persistently nurture a city's knowledge production capacity (Boschma & Frenken, 2010; Malmberg & Maskell, 2002). This approach has underlined the role of collaboration among inventors across locations in different countries as a key dimension of connectivity (*inventor connectivity*) (Cano-Kollmann et al., 2016; Lorenzen & Mudambi, 2013; Scalera, Perri, & Hannigan, 2018). Consequently, international connectivity is higher in locations where firms are active in international innovation networks and where internationally connected inventors abound.

Second, the corporate-organization approach highlights that places are globally connected by a network of advanced producer service firms (e.g., accounting, advertising, consulting, finance, insurance, and law) that follow corporate clients to support their cross-border strategies (Alderson & Beckfield, 2004; Beaverstock et al., 2002; Derudder et al., 2003). Following Belderbos et al. (2017a), we refer to this type of connectivity as *producer services connectivity*.

Finally, the infrastructure-approach underscores the key role played by the physical infrastructure that relies on transportation networks—based on (air)ports, railways, and roads—to facilitate the mobility of both *people* and *goods* and enable communication, interaction, and value-creating relationships through which different places remain connected to each other (Mahutga et al., 2010). This is referred to as *infrastructural connectivity*.

Our conceptualization of connectivity is inspired by an *integrative framework* that embraces these three approaches. Clearly, these different dimensions of connectivity are often intertwined. For instance, physical infrastructures are likely to facilitate both knowledge connectivity and connectivity in producer services, through the mobility of inventors and the employees of producer service firms. Yet, we argue that each dimension has its own specificities, and that it may be relatively more important to explain the foreign location of specific MNE knowledge-intensive activities.

3 | HYPOTHESES DEVELOPMENT

MNE HQ and R&D activities pursue rather distinct objectives and leverage different types of knowledge. Thus, the specific needs of MNEs investing abroad may depend strongly on the type of activity undertaken in the foreign market. Not all MNE knowledge-intensive activities might be equally attracted by the benefits arising from the different dimensions of international connectivity featured in a specific location. In other words, not all types of international connectivity may be equally relevant for the location choices associated with MNEs' knowledge-intensive activities. To account for the potential role of connectivity in the location of different MNE knowledge-intensive activities, we employ the integrative framework described above, which conceives connectivity as a multidimensional construct spanning international networks of inventors, infrastructures, and producer services. Therefore, in what follows, we develop hypotheses based on the idea that different types of connectivity have different implications for the location choices of MNEs' R&D and HQ.

3.1 | Location of R&D activities abroad and international connectivity

Due to cumulative agglomeration processes, technological knowledge is increasingly concentrated in particular geographic locations (Audretsch & Feldman, 1996; Florida, 2005a). The literature suggests that the establishment of a foreign R&D subsidiary is often driven by the MNE's willingness to tap into such repositories of location-specific technological knowledge and centers of excellence in particular industries or technologies (Cantwell, 1989; Cantwell & Mudambi, 2011; Hannigan, Cano-Kollmann, & Mudambi, 2015). This suggests that MNE R&D activities tend to be primarily motivated by the advantages of co-location with other knowledge-intensive firms (e.g., Alcácer, 2006; Alcácer & Chung, 2007; Belderbos, Leten, & Suzuki, 2017; Castellani & Lavoratori, 2020). In fact, geographical proximity facilitates knowledge spillovers, simplifies the transfer of tacit knowledge, favors the establishment and maintenance of effective research collaborations, and reduces search and joint-execution costs (Catalini, 2017; Jaffe, Trajtenberg, & Henderson, 1993).

However, due to the increasing complexity of technologies, the overall innovation process (Gambardella & Torrisi, 1998), and the fine slicing of activities within the global value chain (Mudambi, 2008), it has become highly unlikely that all the know-how and technological competences needed to sustain the innovation process over time are available within a single location (Alcácer & Chung, 2007; Mudambi, 2008). As argued by Bathelt et al. (2004), successful knowledge creation increasingly results from the combination of both *local buzz* and *global pipelines*. The latter allows access to knowledge sources located outside of an organization's surrounding, which can magnify locally embedded learning processes.

Locations that are more connected to geographically dispersed knowledge sources are characterized by a high *inventor connectivity*. An established stream of literature suggests that this is enabled by both organizational pipelines (such as those orchestrated by MNEs and their subsidiaries) and personal relationships among highly skilled individuals (e.g., academic inventors), who collaborate across space to generate new knowledge (Cano-Kollmann et al., 2016; Lorenzen & Mudambi, 2013). Through such geographically distributed channels, technological knowledge circulates internationally, giving rise to linkages that connect locations to the global knowledge environment, nourishing local innovative activities with infusions of foreign technological knowledge (Berman, Marino, & Mudambi, 2020; Perri, Scalera, & Mudambi, 2017).

In line with this evidence, it has recently been suggested that MNEs establish geographically dispersed knowledge-based linkages (Scalera et al., 2018) to exploit the technological heterogeneity and resulting recombination opportunities that characterize both the international and subnational spaces. Due to their extensive participation in inventors' international networks, locations that facilitate the establishment of such linkages are likely to offer advantages that go beyond the traditional value of specialized technological clusters (Turkina & van Assche, 2018).

In other words, besides the role of the unique technological endowment that host locations offer due to the spiky nature of innovation (Castellani, Jimenez, & Zanfei, 2013), MNEs are likely to be attracted by places that enjoy high *inventor connectivity*. Such locations allow easy access to novel, diverse and complementary streams of technological knowledge developed in multiple geographies. Thus, compared to places that are not embedded in international technological knowledge networks, they offer a much wider technological variety and heterogeneous knowledge sources (Berry, 2014). This facilitates the absorption, transfer, and integration of geographically distributed technology, developed both within and outside the MNE's organizational boundaries (Chang & Park, 2005); when recombined with technological knowledge inputs available in the host location, this may generate novel opportunities for knowledge creation. By bringing together technological knowledge and competences from different cultural, institutional, and social contexts (Galunic & Rodan, 1998; Kogut & Zander, 1993), MNE R&D subsidiaries can ultimately improve existing products or processes, or generate innovation.

These arguments lead to the following hypothesis:

Hypothesis (H1). *There is a positive association between the likelihood that an MNE chooses a particular location for its R&D activities abroad and the location's inventor connectivity.*

3.2 | Location of HQ activities abroad and international connectivity

The complex nature of MNEs generates a wide array of strategic decisions, which involve all the stages of the value chain. The role of HQs in shaping, organizing, and monitoring such decisions is critical. The primary objective of HQs is to act as the global integrator of the firm's network. This requires, on the one hand, offering administrative coordination and delivering support services to local units and, on the other hand, fostering knowledge transfer and sharing, creating organizational complementarities, and orchestrating the wide pool of MNE resources (Baaij, Mom, Van Den Bosch, & Volberda, 2015; Baaij & Slangen, 2013; Benito et al., 2011).

To fulfill their administrative coordination roles and to deliver support services, HQs regularly need to source business services such as accounting, advertising, finance, consulting, and human resource management (Henderson & Ono, 2008). Producer services firms with global activities and offices can connect the HQ to these firms' wider networks, leveraging their core advantage based on rapid information exchange (Arzaghi & Henderson, 2008). Thus, HQs can benefit from the presence of internationally connected advanced producer services firms, which can provide these specialized services. Previous literature has shown the importance of co-location between global service providers and their customers, such as MNEs (Dunning & Norman, 1983). This has led such providers to develop multiple branches typically based in key locations like global cities, which are interlinked by worldwide connections (Sassen, 1991). In this way, they reach out more easily to their key customers (namely the MNEs), and simultaneously reduce the need for the MNE HQs to look for different providers in each foreign location (Goerzen et al., 2013). Hence, ideal locations for host country or regional HQs should offer a large supply of globally connected advanced service producers, to maximize the choice set of service suppliers available to the MNE and enhance the possibility to efficiently outsource strategic support activities across borders (Henderson & Ono, 2008; Holloway & Wheeler, 1991). Most importantly, the availability of connections through global service providers (*producer services connectivity*) enables the HQ to leverage their dispersed networks to reach out to the different MNEs' subsidiaries and deliver customized support activities, thus reducing the transaction and coordination costs of the HQ's administrative role. Based on this reasoning, we suggest the following:

Hypothesis (H2a). *There is a positive association between the likelihood that an MNE chooses a particular location for its HQ activities abroad and the location's producer services connectivity.*

Moving to the HQs' role as central facilitator of knowledge transfer and sharing, creator of organizational complementarities, and orchestrator of MNE resources worldwide, it behooves the HQ's managers to be able to develop and maintain links with different internal and external actors, both within and outside the home country. This allows for an effective and efficient exchange of knowledge and other valuable resources.

A prerequisite to the establishment of such connections across distance is often the temporary co-location of key actors. This is the case of managers or employees at the HQ level and relevant spokespersons in MNE subsidiaries or in other external organizations, including strategic suppliers offering support services (e.g., accounting, law, or consultancy firms), industry partners or institutions (Torre, 2008). Empirical evidence strongly supports the importance of temporary co-location in the HQ's relations with both its internal and external stakeholders (Choudhury, 2017; O'Donnell, 2000; Solomon & Soltes, 2015). Thus, the mobility of individuals from and to the HQ's locations is crucial to facilitate effective decision-making and intra-MNE resource orchestration, foster knowledge transfer and sharing, and enable the emergence of organizational synergies; these activities imply a high degree of tacit knowledge and know-how, which tends to require on-site visits and face-to-face communications, rather than remote communication (e.g., emails, telephone, video conferencing) (Belderbos et al., 2017a; O'Donnell, 2000). Virtual communication and face-to-face contact, entail different advantages, even if they complement each other. While the former is more suitable for standardized and codified information, the latter offers the possibility to transfer not only tacit knowledge, but also motivation and nonverbal messages (Gaspar & Glaeser, 1998; Storper & Venables, 2004).

Thus, the choice of where to locate host country or regional HQ facilities is most likely dependent on the degree of *infrastructural connectivity* that allows the mobility of people. In fact, to reduce the spatial transaction costs of knowledge transfer (Cano-Kollmann et al., 2016), MNEs will more likely minimize travel costs and management time by establishing HQs in locations offering high-quality transport services, and infrastructures that are nodes of passenger transportation networks, facilitating people mobility (Bel & Fageda, 2008).

Therefore, these arguments lead to the following:

Hypothesis (H2b). *There is a positive association between the likelihood that an MNE chooses a particular location for its HQ activities abroad and the location's infrastructural connectivity for the mobility of people.*

4 | EMPIRICAL STRATEGY: DATA, VARIABLES, AND ESTIMATION METHOD

4.1 | Data

The empirical analysis draws on data gathered from *fDi Markets*, a database established by the Financial Times Ltd., which tracks cross-border greenfield investments across different industries and countries, worldwide (for more details, see http://www.fdimarkets.com/). The database contains investment projects covering several business activities, such as R&D, production, HQs, business service, ICT, logistics, marketing and sales, education and training, and technical support. Among other information, the database includes the name of the investing company, its home country and city, the main industry and the business activity involved in the project, and the location of the project destination in terms of the host country and city.

This study focuses on investment projects whose main activity is either R&D or HQ, the two knowledge-based activities singled out in our conceptualization. For comparison, we further extend our analysis to other types of MNE activities along the value chain, such as production, logistics, and sales. This allows us to highlight how locational determinants of knowledge-intensive activities differ from those of less knowledge-intensive activities. Our sample consists of a total of 3,101 investment projects by foreign MNEs in the US over the period 2009–2014.[2] Out of these, 519 involve investments in HQ activities, 247 projects in R&D activities,[3] 638 in operations (which include production and logistics), and 1,697 projects in sales (including marketing and customer support).[4]

Each project within the US is geo-referenced based on the information of the destination city. To enable reference to relevant economic subnational areas, rather than purely administrative boundaries, and for the purpose of increasing the degree of comparability across locations and improve data availability, we then assign each project to a Core Based Statistical Area (CBSA). CBSAs are geographic areas—defined by the US Office of Management and Budget (OMB)—which consist of one or more counties that contain one core urban area of 10,000 or more inhabitants, with the adjacent communities having a high degree of social and economic integration (measured in terms of commuting ties) with the urban core. A CBSA can be classified either as a Micropolitan or Metropolitan statistical area based on its population. Specifically, above the threshold population of 50,000, a CBSA is classified as Metropolitan statistical area. Collectively, MSAs accounted for more than 90% of US GDP in 2016, with the five largest metropolitan areas (New York–Newark–Jersey City, Los Angeles–Long Beach–Anaheim, Chicago–Napeville–Elgin, Dallas–Fort Worth–Arlington, Houston–The Woodlands–Sugar Land) accounting for almost a quarter of national GDP (Hinson, Panek, & Rodriguez, 2017). According to fDi Markets, out of all the investment projects in R&D, HQ, operations, and sales activities in the United States over the 2009–2014 period, 96.6% were directed toward MSAs and only 3.4% to Micropolitan Statistical Areas. Therefore, without loss of generality, we can assume that Micropolitan areas are largely irrelevant for MNEs' location decisions and thus focus our analysis on MSAs.

The cross-border investment projects analyzed in this study take place in 145 (out of 381) MSAs. Figures A.I–A.IV in the Supporting Information (Online Appendix) show the geographical distribution of different types of investments by MSA. It is evident that MNE activities are very concentrated in a few MSAs, and this study aims to explain such location patterns. While geographical concentration is a feature of all MNE activities, some of them, like R&D and HQ, are more geographically concentrated than others, such as production and logistics (operations), giving rise to what Mudambi et al. (2018) refer to as a “trumpet.” Consistent with this view, Figure A.V in the Supporting Information (Online Appendix) highlights these different concentration patterns among investment types. Investments in R&D and HQs occur in 57 and 62 MSAs, respectively, while investments in operations and sales occur in 118 and 92 MSAs respectively. The top 25 MSAs account for more than 80% of the total number of R&D and HQ investments. For comparison, the concentration of overall economic activity is much lower, with the first 25 MSAs accounting for 55% of US GDP. Operation activities tend to follow a pattern more in line with GDP, so about 60% is concentrated in the top 25 cities, although more than 65% of all MSAs receive zero investments in production activities by foreign MNEs over the 2009–2014 period. Instead, sales (including marketing) present a mixed pattern, with about 47% of projects concentrated in four MSAs (i.e., New York, San Francisco, Los Angeles, and Boston), and the remaining investments spread out across the other 88 MSAs. Table A.I in the Supporting Information (Online Appendix) reports the number of FDI in HQ, R&D, operations, and sales, respectively, for the top 25 MSAs in terms of GDP over the period of analysis. It is worth noting that the ranking of MSAs in terms of GDP does not necessarily correspond to a higher number of FDI projects.

4.2 | Variables

4.2.1 | Dependent variable

The dependent variable is the location choice of a new investment project. This is a binary variable taking a value of 1 if a given project i, made by the firm f is located in the MSA r, and 0 for all the other possible alternative MSAs (not chosen) $r \neq r^*$. Due to the data availability for some of the main variables of interest, the final location choice set for the investments is composed of 216 (instead of 381) US MSAs.[5] However, we also estimate the model removing the problematic variables on the enlarged choice set of MSAs, and our results persist.

4.2.2 | Main explanatory variables

Inventor connectivity

We measure the location's *Inventor Connectivity* as the number of internationally connected patents originating from each specific MSA. We collected information about the granted patents applied to the United States Patent and Trademark Office (USPTO) using the "Disambiguation and Co-authorship Networks of the U.S. Patent Inventor Database (1975–2010)," which provides, among other information, the address of the patent inventors after a systematic process of disambiguation (Li et al., 2014). Following previous research (Hannigan, Cano-Kollmann, & Mudambi, 2015; Mudambi, Mudambi, Mukherjee, & Scalera, 2017), we use this information in two ways. First, we geo-reference each inventor and assign the related patent to a certain MSA, using the location of the inventor. If a patent has one or more inventors resident outside the United States, we classified it as "internationally connected." Then, we count the internationally connected patents by MSA in the period 2001–2003. Despite information on geo-referenced patents being available until 2010, this time period has been chosen because numbers drop remarkably after 2003, leading to potential distortions in the geographical distribution across MSAs. To enable interpretation of this count as an elasticity, we take the natural logarithm (adding 1 to the count to avoid a log of zero in the MSA that had no internationally connected patents).

Consistent with our theoretical framework, this measure captures the linkages that inventors located in a specific MSA maintain with other inventors located abroad. When inventors that are based in different countries collaborate to generate innovation, the underlying technological knowledge generation process becomes international, and can only occur because the actors of such process are linked to each other despite being geographically separated. Such linkages may be orchestrated by organizations, such as MNEs, that require their knowledge workers in different national units to join the same innovation team, or are motivated by personal relationships, such as those established by academic researchers who collaborate with peers located in foreign universities (Berman et al., 2020; Perri et al., 2017).

Producer services connectivity

We measure *Producer Services Connectivity* using the classification developed by the Globalization and World Cities Network (GaWC). Taylor (2001) provides a list of around 300 cities worldwide, based on their global connectivity through advanced producer service firms in four main services (i.e., accountancy, advertising, banking/finance, law) and their worldwide networks. To develop a measure of a city's integration into the world city network, the GaWC utilizes interlocking network models (for more details, see https://www.lboro.ac.uk/gawc/). The idea behind this measure is that a city which hosts several advanced producer service firms that have offices in many other cities is better connected than a city with fewer advanced producer service firms with offices in fewer locations.

Fifty cities included in the GaWC list are located in the United States and are ranked depending on the level of integration of producer service firms as *Alpha* (e.g., New York, Chicago, Los Angeles, and San Francisco), *Beta* (e.g., Boston, Philadelphia, and San Diego), *Gamma* (e.g., San Jose, Phoenix, and Orlando), *High Sufficiency* (e.g., Austin, Pittsburgh, and Indianapolis), and *Sufficiently Global* (e.g., San Antonio, Las Vegas, and Sacramento). *Alpha* cities are those with the highest level of international producer service connectivity and the *Sufficiently Global* cities are those with the lowest level. Following this classification, we assign the US global cities included in the list to their corresponding MSA. Our final measure is a categorical variable that takes a value of 0 if the MSA does not have any cities classified as global within its administrative boundaries, while it assumes a value from 1 (in the case of *Sufficiently Global* cities) to 5 (in the case of *Alpha* cities) depending on the highest level of producer service connectivity of cities located within a specific MSA.

Infrastructural connectivity

We measure a location's *Infrastructural Connectivity* through different indicators that capture a location's endowment with infrastructures that allow, first and foremost, a smoother international *mobility of people*. Expressly, we first compute the number of international and total passengers from and to each airport located in the United States in 2008, which is the year prior to our observation period, using data from the Bureau of Transportation Statistics (as reported on https://www.transtats.bts.gov/databases.asp?Z1qr_VQ=E&Z1qr_Qr5p=N8vn6v10&f7owrp6_VQF=D). Then, we geo-reference each airport to assign it to its correspondent MSA and compute the total number of international air passengers as a share of total passengers by MSA.

Second, we include a measure of international direct flights as in Bel and Fageda (2008). For this measure, we collected data on international direct (nonstop) routes from the *OpenFlights* database (for more details, see https://openflights.org/data.html). We geo-reference each airport and assign it to an MSA. This allows us to compute the total number of international direct routes as a share of total routes for each MSA. We find that only 60 airports have international nonstop routes, corresponding to 50 MSAs. Unfortunately, data on international flights were not available before the year 2014, so there may be some minor endogeneity concerns because this variable is measured at the end of the period of our empirical analysis. Third, we also include the number of national (intra-US) business passengers as a share of total passengers to distinguish business locations from those that are mainly attractive for tourists and leisure travelers. The Airline Origin and Destination Survey (DB1B) (https://www.transtats.bts.gov/DatabaseInfo.asp?QO_VQ=EFI&Yv0x=D), made available by the Office of Airline Information (part of the Bureau of Transportation Statistics), provides fare class details (e.g., business, first, coach) for a 10% sample of all airline tickets reporting carriers. After geo-referencing the airports, we derive the number of business tickets for each MSA. Unfortunately, this information is only available for national flights, so it is not the most appropriate measure for international connectivity. Though, we expect that MSAs which feature a high domestic business travel, are also likely to have a higher number of international business travel.

Based on our conceptualization of connectivity, we also aim at controlling for the extent of physical infrastructure that facilitates the international movement of goods in and out of an MSA. Such infrastructures can span across air, land and sea and we use several measures to capture these different aspects. First, we use the total volume of export of goods in US dollars from each MSA in the year prior to each of the cross-border investment projects considered in the analysis, as reported by US Department of Commerce. Ideally, one would want to measure exported quantities, rather than values, but unfortunately this information is not available (for more details, see http://tse.export.gov/metro). While this measure does not explicitly capture the extent of infrastructural connectivity, we submit that, controlling for GDP and other local characteristics, MSAs that trade more in goods are also more likely to offer better physical infrastructures for export and import of goods. Unfortunately, to the best of our knowledge, import data are not available at the MSA level, so we cannot assess both sides of trade. Though, we expect import and export to be highly correlated, so the lack of a measure of imports at the MSA level should not be too problematic. Indeed, import and export at the US State level have a correlation of 93.4%. Second, we control for the number of major seaports and river ports at

MSA level, provided by the Bureau of Transportation Statistics (for more details, see https://data-usdot.opendata.arcgis.com/datasets/major-ports). We have 134 ports, spread out across 70 MSAs.

Control variables

We control for a rich set of MSA and firm-MSA characteristics, as described in the following.

First, we compute measures of the *technological strength* of an MSA using data from USPTO and the "Disambiguation and Co-authorship Networks of the U.S. Patent Inventor Database (1975–2010)" database. We identify the number of patents within the same technological class of the cross-border investment and in other technological classes. The former is intended to capture the MSA strength in the specific technological field where the MNE investment takes place, while the latter aims at capturing a more general technological strength of the MSA. fDi Markets provides information on the main sector where the cross-border investment takes place, but not the technological class. Thus, we devised a correspondence table between the sector in which the project takes place, and the technological class. This correspondence table is available from the authors upon request. These variables are complemented with a measure of *technological diversification* of the MSA, computed as one minus the Herfindahl index of patents with inventors in an MSA, across technological classes. We include these strength and diversification measures as an average of the related indexes in the period 2001–2003.[6]

Second, we introduce a vector of variables capturing *agglomeration economies*. On the one hand, to account for the number of firms in each MSA, we use data from the US Census to build a variable computed as the mean of the number of firms in the 5-year period prior to our observation period (2003–2007). This variable is also entered in quadratic form to allow for possible inverted-U shape effects of agglomeration economies, due to congestion effects. On the other hand, we allow for specific agglomeration effects stemming from previous MNE investments and path dependent processes in investment decisions. We compute the overall number of investment projects in an MSA from 2003 until the year prior to the investment, as well as the share of investments in the specific activities considered in this study, namely R&D, HQ, operations, and sales. It is expected that MSAs that have attracted investments in the past will continue to be attractive and that this may be activity-specific (e.g., MSAs that have attracted more R&D in the past will keep being particularly attractive for this type of activity). These variables can also serve to capture some unobserved heterogeneity at the MSA level. Furthermore, we include a measure of the firm's prior experience in the same MSA, allowing for path-dependence as a driver of MNE internationalization decisions, and measured as the cumulated number of investments made by the MNE in each MSA from 2003 until the year prior to the investment. Data are gathered from fDi Markets.

Third, we augment our specification with standard controls for *size* (GDP, land area, and population), *cost of labor* (average wages from the US Bureau of Economic Analysis, BEA) in the year before each investment takes place, and *human capital*. We proxy the level of human capital in the MSA by the number of domestic immigrants from other MSAs in the period 1995–2000 (source: US Census, https://www.census.gov/topics/population/migration/guidance/metro-to-metro-migration-flows/census-2000). This choice is in line with several studies suggesting that domestic migration (between MSAs) consists primarily of skilled workers moving toward more affluent metropolitan areas, where there is a higher level of human capital, employment, and remuneration opportunities (e.g., Dahl & Sorenson, 2010; Storper, 2010). Hence, we submit that larger flows of domestic migration will raise the level of human capital. We then control for the endowment of amenities in an MSA, computed as the share of GDP in the Arts and Entertainment sector (from the BEA) in the year before each investment takes place. We expect that this variable makes a location especially attractive for creative activities and professionals.

Fourth, we control for the geographical characteristics of each location, such as their geographical coordinates (longitude and latitude), and the geographical distance between the home city of the investing companies and the MSA.

Finally, as an additional control of intra-US infrastructural connectivity for people and goods, we include a measure of railroad infrastructure, computed as the sum of kilometers of rail lines located in each MSA. The Rail Network database of the Bureau of Transportation Statistics provides the shapefile of the North America railway system (for more details, see https://data-usdot.opendata.arcgis.com/datasets/north-american-rail-lines), with all the rail lines and nodes, and the corresponding line length (in kilometers). We assign each line to the related MSA, and then compute the total kilometers of rail lines, using the QGIS software. We find 377 MSAs covered by rail routes, with an average rail line length of 424 km. As we control (among other things) for land area, population, and GDP of the MSA, these measures can be interpreted as intensities, rather than the absolute values they represent.

Table 1 reports the list and a detailed description of all variables included in the empirical analysis.

4.3 | Estimation method

To test our hypotheses, we estimate a Conditional Logit model—CLM (McFadden, 1974), in line with location choice literature (Arauzo-Carod, Liviano-Solis, & Manjón-Antolín, 2010; Nielsen et al., 2017). The CLM assumes that a firm chooses the location that provides the largest net-expected profit. The expected profit associated with the different locations is not directly observed, but we can infer them from the characteristics of the chosen location and the characteristics of all the alternative choices, in our case, the MSAs. Thus, the model assumes that for the investment *i*, which takes place in location *r*, this location yields the highest profit of all possible alternatives. Assuming an extreme value distribution of the error term, the probability that, for the investment *i*, a firm chooses the MSA *r*, can be formally expressed by the following equation:

$$P_{ir*}^{CL} = \frac{\exp(\beta X_{ir*})}{\sum_{r=1}^{R-1} \exp(\beta X_{ir})}, \forall r \neq r*(r = 1, \dots, R-1)$$

where X is a vector of location-specific and firm-location characteristics, in the year before the investment.[7] It is worth mentioning that, due to the characteristics of the CLM, vector X cannot include any firm-specific characteristics. This is because the model is built on the assumption that firms choose the location that yields the highest expected profit, and any variable that does not vary across locations, such as firm characteristics, does not affect the difference in profitability that a given firm perceives from one MSA relative to another (Train, 2003). The CLM is characterized by the assumption of the independence of irrelevant alternatives, according to which the relative choice probabilities between two alternatives is independent of the characteristics of the alternatives in the choice set. In further analysis (available from the authors upon request), we test our models by estimating a Mixed Logit (MXL) model that totally relaxes this assumption (Basile, Castellani, & Zanfei, 2008; Castellani & Lavoratori, 2020; Train, 2003).

TABLE 1 List and description of independent variables

Variable	Description	Level	Source
International connectivity			
Inventor	Number of internationally connected patents (at least one co-inventor outside US) (log)	MSA	USPTO/ Harvard Dataverse
Producer services	Index ranging from 0 to 5 according to the position of cities -within the MSA- in the globalization and World City network classification (0 not in GaWC, 1 sufficiently global, 5 alpha cities)	City	Globalization and World Cities (GaWC)
Infrastructural (people)	Number of international passengers at airports, as a share of total passengers	MSA	Bureau of Transportation Statistics
	Number of international direct (nonstop) routes at airports, as a share of total direct routes	MSA	Openflight
	Number of national (intra-USA) business passengers, as a share of total passengers	MSA	Airline Origin and Destination Survey
Infrastructural (goods)	Export of goods (in US $) from the MSA (log)	MSA	US Dept. of Commerce
	Number of major seaports	MSA	Bureau of Transportation Statistics
Technology and human capital			
No. of patents (same tech class)	Number of patents within sector/technological class of FDI (log)	MSA	USPTO
No. of patents (other tech class)	Number of patents in different sector/technological class of FDI (log)	MSA	USPTO
Tech. Diversification	Diversification index of patent technological classes (log)	MSA	USPTO
Domestic migration	Number of domestic migrants (from other MSAs) between 1995–2000	MSA	US Census
Agglomeration economies			
No. of firms	Number of firms (average, 2003–2007) (log)	MSA	US Census
No. of firms (sq)	Squared number of firms (2003–2007) (log)	MSA	US Census
No. of previous investments in MSA	Cumulated number of total investment projects (2003 - t-1) at the MSA level	MSA	fDi Markets
Share R&D inv.	Share of R&D investment projects on the total number of projects (%)	MSA	fDi Markets
Share operations inv.	Share of manufacturing and logistics investment projects on the total number of projects (%)	MSA	fDi Markets
Share HQ inv.	Share of HQ investment projects on the total number of projects (%)	MSA	fDi Markets

(Continues)

TABLE 1 (Continued)

Variable	Description	Level	Source
Share sales inv.	Share of sales investment projects on the total number of projects (%)	MSA	fDi Markets
Firm-MSA experience	Cumulated number of total investment projects (2003-t-1), made by the same parent company in the MSA	Firm-MSA	fDi Markets
Other controls			
Population	Population (log)	MSA	BEA
GDP	GDP (log)	MSA	BEA
Wages	Average wage in nonfarm employment (log)	MSA	BEA
Share of GDP in Arts & Entertainment	Share of GDP in arts and entertainment sector	MSA	BEA
Geographical distance (from home city)	Geographical distance between from home city and host MSA	Home City-MSA	fDi Markets
MSA area	MSA land area in kilometer square (log)	MSA	US Census
Latitude/ longitude	Geographical coordinates (latitude/longitude) of MSA	MSA	fDi Markets
Km railroad	Sum of kilometers of rail lines located in the MSA (log)	MSA	Bureau of Transportation Statistics

5 | RESULTS

Tables A.II and A.III in the Supporting Information (Online Appendix) provide some descriptive statistics and a correlation matrix. It is worth mentioning that some variables exhibit high pairwise correlations. This may raise concerns of possible multicollinearity problems, but we are reassured by the fact that in the subsequent econometric estimations, standard errors are generally low and all variables are significant in explaining at least one type of MNE activity. As noted by Lindner, Puck, and Verbeke (2019), dropping variables that are highly correlated may lead to estimation bias and spurious correlation due to the deflation of standard errors. In their words, "[i]f in doubt, a researcher would be well advised to keep the variables in the regression model. Although this may inflate standard errors, it will not create spurious results" (p. 288). To eliminate doubt, we perform some checks to identify possible multicollinearity issues among our main independent variables, and the measures of international connectivity. First, we notice from Table A.III that pairwise correlations between these measures are not extremely high (generally around 0.6, and reaching 0.8 only in the case of the correlation between goods and inventor connectivity). Second, we estimate the econometric specifications by introducing one measure at time. Results from these estimations, which are available from the authors upon request, do not show significant variations relative to our baseline model where all measures are introduced simultaneously.

5.1 | Main results

Table 2 presents the main results of our econometric estimation, where we run separate regressions estimating the determinants of the location choice for the different types of investments in US MSAs. Our baseline estimation is run on the samples of R&D and HQ investments, but we also include additional evidence on the sample of investments in operations (which include production and logistics) and sales (and marketing) activities.

Turning to the main variables of interest, consistent with H1, R&D is indeed quite sensitive to *inventor connectivity*, but not at all affected by other aspects of connectivity. Instead, as predicted by H2a, a high degree of *producer services connectivity* is a driving factor for the location decisions of foreign HQ activities. This finding suggests that HQs are attracted toward locations characterized by a high density of advanced service providers with a strong international network. This locational feature allows the MNE to work with the same providers and reach out to its different subsidiaries located in several locations worldwide, benefiting from customized and integrated services. Additionally, this facilitates the strategic decision of outsourcing support activities, such as law, accounting, finance, and consulting, due to the large supply of global services.

Finally, the number of international passengers at airports is positively associated with the location of HQ activities, as predicted by H2b. This is consistent with the idea that MNEs will more likely minimize travel costs and management time by establishing HQs in locations offering high quality transport services and infrastructures that are nodes of passenger global transportation networks. These findings are validated when we consider other measures of infrastructural connectivity, i.e., national business passengers, international direct routes, and major seaports. We do indeed find that MSAs that have more business passengers flying from/ to their airports are more attractive for HQ units, due to their peculiar role as orchestrators and providers of administrative support to the MNE network.[8]

5.2 | Additional analyses

Our main conceptualization and empirical analysis focuses on the specificities of knowledge-intensive MNEs' activities and highlights how different aspects of international connectivity may be relevant for their location choices. However, these are not the only activities in the value chain. While developing a conceptualization of the role of international connectivity spanning the whole value chain is beyond the scope of this paper, it is worth exploiting the richness of the data at our disposal to provide some evidence beyond knowledge-intensive activities. Columns (3) and (4) of Table 2 show conditional logit estimates for the subsample of cross-border investment projects in operations (production and logistics) and sales (and marketing) activities, respectively.

The role of *international connectivity* indeed differs for such activities. MNEs investments in operations are more attracted toward locations with more exporting activities and denser railroad networks that can signal better *infrastructural connectivity for the mobility of goods*. We also find that the share of international passengers at airports, which is our measure of *infrastructural connectivity for the mobility of people*, is positively associated with the location of operations activities. This may be consistent with the idea that operations are now part of a complex manufacturing integration system that also requires frequent interactions of several people involved in different stages of the value chain and in different locations, especially when

TABLE 2 Determinants of MNEs location decision for new international investment projects—Conditional logit model

	Location decision of new international investment projects			
	R&D	**HQs**	**Operations**	**Sales**
International connectivity				
Inventor connectivity				
No. of intl. connected patents	1.0191***	−0.1544	−0.0832	0.0761
	(0.3660)	(0.2616)	(0.1570)	(0.1737)
Producer service connectivity				
GaWC index ranking	−0.0012	0.2852***	0.0256	0.2241***
	(0.1149)	(0.0959)	(0.0744)	(0.0614)
Infrastructural (people) connectivity				
Share of international passengers	0.0166	1.0180**	0.4501**	0.1859
	(0.5321)	(0.4847)	(0.1916)	(0.2676)
Share of intl. direct (nonstop) routes	−1.0313	1.1306	−0.7836	0.4496
	(1.6460)	(0.9763)	(0.8050)	(0.5866)
Share of business passengers	−0.9054	1.1106**	−0.5396	−0.4653
	(0.7984)	(0.5076)	(0.3678)	(0.3740)
Infrastructural (goods) connectivity				
Exports	0.0755	−0.0095	0.2568***	−0.0176
	(0.2612)	(0.1310)	(0.0722)	(0.0828)
No. of major ports	−0.1292*	0.0347	−0.0012	0.0065
	(0.0692)	(0.0381)	(0.0357)	(0.0240)
Technology and human capital				
No. of patents (same tech class)	0.5821***	0.7539***	0.4961***	0.8636***
	(0.1535)	(0.1110)	(0.0914)	(0.0698)
No. of patents (other tech class)	−0.9213***	0.066	−0.4161**	−0.3543**
	(0.3144)	(0.2710)	(0.1615)	(0.1651)
Tech. diversification	−1.3785*	0.2171	−0.614	−0.3853
	(0.7814)	(1.3954)	(0.6075)	(0.9573)
Domestic migration	0.9932*	1.2253***	0.7282***	0.0059
	(0.5378)	(0.3658)	(0.2338)	(0.2538)
Agglomeration economies				
No. of firms	1.2399	3.1314**	1.5167	2.4487**
	(2.3542)	(1.5562)	(0.9926)	(1.0466)
No. of firms (sq)	−0.042	−0.1524**	−0.1085**	−0.1151***
	(0.0997)	(0.0651)	(0.0504)	(0.0430)
No. of previous inv. in MSA	0.0014*	0.0027***	0.0014**	0.0023***
	(0.0008)	(0.0006)	(0.0007)	(0.0003)
Share R&D inv.	2.2677***	−0.2712	−1.7028***	−1.3534**
	(0.8462)	(0.9859)	(0.6374)	(0.6397)
Share HQ inv.	2.4606**	2.0786***	0.9774**	1.4128***
	(1.2182)	(0.7684)	(0.4977)	(0.4963)

TABLE 2 (Continued)

	Location decision of new international investment projects			
	R&D	**HQs**	**Operations**	**Sales**
Share operations inv.	0.5769	1.4969**	1.0117***	0.9011***
	(0.7016)	(0.6701)	(0.2500)	(0.3287)
Share sales inv.	0.1966	0.9534	−0.0817	0.8453**
	(0.7951)	(0.6648)	(0.4184)	(0.3962)
Firm-MSA experience	0.6112***	1.0904***	0.8401***	−0.4840*
	(0.2248)	(0.2529)	(0.2594)	(0.2889)
Other controls				
Population	−1.5264	−1.7825**	1.0002**	−1.0682**
	(1.0712)	(0.7862)	(0.4084)	(0.4854)
GDP	0.8662	1.5127***	1.1952***	0.6452
	(0.7502)	(0.5549)	(0.3688)	(0.4080)
Wages	−0.074	−0.9961*	−1.5209***	0.7601*
	(0.9537)	(0.6071)	(0.4425)	(0.4604)
Geographical distance	−0.5150**	−1.0548***	−0.8795***	−0.5300***
	(0.2227)	(0.2102)	(0.2324)	(0.1306)
MSA area (km^2)	−0.3319	0.1418	−0.5146***	0.0662
	(0.2981)	(0.1917)	(0.1459)	(0.1160)
MSA latitude	−0.0313	−0.0303	−0.0054	−0.0556***
	(0.0294)	(0.0212)	(0.0160)	(0.0148)
MSA longitude	−0.0118*	0.0195***	−0.0001	−0.0016
	(0.0064)	(0.0045)	(0.0044)	(0.0031)
Share of GDP in Arts & Entert.	0.093	4.0873*	−2.2086	3.2327**
	(4.5149)	(2.2749)	(2.0184)	(1.5377)
Km railroad	0.4040*	0.1474	0.5062***	−0.0645
	(0.2403)	(0.1485)	(0.1354)	(0.0896)
No. of obs	52,883	111,154	136,634	363,402
No. of MNEs	213	507	510	1,423
Pseudo-R^2	0.3206	0.3598	0.1779	0.4222
Log-likelihood	−900.5731	−1783.127	−2,814.762	−5,261.698

Notes: The dependent variable is the location decision of a new investment i in the MSA r, in R&D, HQs, Operations and sales over the period 2009–2014. Operations include production and logistics activities, while sales include marketing and sales activities. The total number of investments is 247, 519, 638 and 1,697, respectively. Standard errors are clustered by firm and reported in parentheses. Asterisks denote confidence levels:
$^{*}p < .10$.
$^{**}p < .05$.
$^{***}p < .01$.

knowledge-intensive and more mobile activities are involved (Berry, 2014; Lavoratori et al., 2020). Instead, sales and marketing as downstream activities in the firm's value chain are attracted by MSAs with a higher degree of *producer services connectivity*, which are typically more highly-connected global cities characterized by a diverse and cosmopolitan environment (Asmussen et al., 2019; Belderbos et al., 2020). Investments in demand-driven activities may therefore aim at reaching new customers and supporting the existing ones, as well as enlarging MNE presence in regional and local markets and targeting local customer preferences. Thus, global cities may mitigate the liability of foreignness in targeting local customers (Belderbos et al., 2020). Additionally, these enable the MNE to efficiently combine its resources and capabilities with the availability of market-oriented service providers and communications channels, in addition to intercity relations with other global cities and "seamless" service providers (Derudder et al., 2010; Goerzen et al., 2013).

5.3 | Results on control variables

Results on the control variables highlight both similarities and differences in the location determinants of different activities across the value chain. The degree of technological strength of an MSA is positive and significant across the board. Interestingly, the degree of technological diversification is statistically significant only for the location of investments in R&D. The negative sign is consistent with the fact that MNEs locate R&D in very specialized MSAs. The results are also consistent with the idea that MSAs which attract more intra-US migration have higher endowments of human capital.

Consistent with theory, the market size of MSAs is generally associated with more MNE activity. Agglomeration economies generally have a positive effect on the attractiveness of an MSA to MNE investments, although the evidence suggests the possibility of congestion costs kicking in after a certain level of agglomeration economy. The results also highlight that MNEs investments in a certain type of activity tend to be attracted toward MSAs where MNEs have invested in the same activity in the past (Alcácer & Delgado, 2016; Basile et al., 2008; Castellani & Lavoratori, 2020; Lavoratori et al., 2020). The quality of life, in terms of cultural activities and entertainment opportunities, could be particularly important to attract creative professionals (Florida, 2005b) and provide top managers the incentive to live in such cities.

Finally, geographic distance between the home city of the investing MNE is negatively correlated with MNEs investments but, consistently with earlier literature, this effect is smaller in magnitude for R&D activities (Castellani et al., 2013) and larger for HQ activities (Baaij & Slangen, 2013). Higher wages are generally negatively associated with MNEs investments and, not surprisingly, this is more important for operations activities.

6 | DISCUSSION AND CONCLUSIONS

This work extends a stream of studies on the micro-level spatial determinants of MNE location choices (Asmussen et al., 2019; Belderbos et al., 2017a, 2020; Goerzen et al., 2013; Ma, Delios, & Lau, 2013). Embracing perspectives on the importance of subnational spatial heterogeneity as a core driver of MNE location choices (Beugelsdijk & Mudambi, 2013; Mudambi et al., 2018), we focus on the metropolitan area as a relevant level of analysis, and link individual components of the complex construct of international connectivity (Asmussen et al., 2019; Belderbos et al., 2017a; Goerzen et al., 2013) to the location decisions of two key knowledge-intensive activities of the MNE, that is, R&D and HQ.

Our results reveal that unpacking the different aspects of connectivity can indeed lead to important insights and unfold relationships that might not emerge when using synthetic indexes. Specifically, MNE R&D activities are attracted toward locations that allow the firm to access an internationally connected network of inventors, while no effect emerges with respect to other measures of connectivity, such as those based on flows of goods and people from/to a place. Instead, the key dimensions of connectivity for the location of MNEs' HQ units are the ties that connect geographically dispersed locations to networks of advanced producer service firms that support their corporate clients in their cross-border strategies, along with the infrastructures that facilitate the international mobility of people.

Our approach makes several contributions. First, we add to the recent stream of research on the concept of international connectivity (Belderbos et al., 2017a; Cano-Kollmann et al., 2016; Goerzen et al., 2013; Lorenzen & Mudambi, 2013; Ma, Delios, & Lau, 2013; Perri et al., 2017; Scalera et al., 2018). While connectivity is a multidimensional construct (Belderbos et al., 2017a), its different dimensions deserve to be accounted for individually when used to explore firm strategic behavior. Importantly, our study brings together a wide range of dimensions of connectivity, spanning knowledge, infrastructure, and producer services that have seldom been studied jointly.

Second, our study contributes to the literature on MNE location choices (e.g., Alcácer & Chung, 2007; Alcácer & Delgado, 2016; Asmussen et al., 2019; Benito et al., 2011) by zooming in on the knowledge-intensive activities that are often responsible for MNEs' competitive advantage, that is, R&D and HQ. This allows us to demonstrate that, although both activities make intense use of knowledge, they are attracted by entirely different dimensions of connectivity.

Our fine-grained approach also extends the findings of previous empirical literature that focused on FDI stocks (e.g., Asmussen et al., 2019) and reinforces the bridge between economic geography perspectives and international business studies (Beugelsdijk & Mudambi, 2013). This is accomplished by showing that both micro-level spatial heterogeneity, captured in terms of different dimensions of connectivity, and MNEs' activities heterogeneity, reflected in the nature of MNEs knowledge-intensive activities overseas, jointly determine location decisions.

This work is not without limitations, which create potential avenues for future research. First, we are unable to go beyond the functional distinction among R&D, HQ, operations and sales activities, and to investigate more discrete and separate value chain tasks. For example, one could go even deeper into operations and R&D activities to highlight the extent to which certain manufacturing activities contain elements of innovation, and R&D contains elements of manufacturing (e.g., prototyping). While we were constrained by data availability, future studies could reveal that within-activity heterogeneity affects MNE location decisions. Second, our measures of connectivity are based on the observations of actual connections of inventors and advanced producer services firms, and the mobility of people and goods. Ideally, one would like to further identify the drivers of such connections. Moreover, in the case of knowledge connectivity, one may also observe that, being based on co-invention, our measure may be better suited to capture the international connectivity of relatively more codified knowledge.

Third, while our study provides novel evidence on the differentiated role of different dimensions of international connectivity in attracting MNEs' activities in city-regions, it does not delve into the downside of international connectivity. As noted by Lorenzen, Mudambi, and Schotter (2020), MNEs attracted by the international connectivity of city-regions can exacerbate local disconnection between the city core and in its catchment area. In the long run, this can be detrimental for local development, aggravate local populist policy responses, and pose a threat to MNE performance. Future research could build on our study to show the conditions under which international connectivity can instead spur the renewal of local connections, through the mediating role of MNEs engagement in local spawning strategies (Lorenzen et al., 2020).

Our work also has relevant implications for MNE managers involved in location decisions and policy making. As far as the former audience is concerned, our findings suggest that locations that perform well as attractors of one specific type of knowledge-intensive activity might not be ideal to carry out other types of activities that, while featuring similar degrees of knowledge intensity, make use of knowledge of a different nature and, thus, require different types of connections to worldwide locations. For instance, leading technology clusters that provide access to global knowledge linkages via their resident inventors are not necessarily convenient locations for MNEs' HQ activities, because they might lack a sufficient degree of advanced producer services connectivity or a limited endowment with infrastructures for the international mobility of people. Thus, some places could end up attracting primarily specific types of MNE activities—potentially generating self-reinforcing mechanisms like asset-mass efficiency (Dierickx & Cool, 1989)—that over time could increase the task specialization of the locations. In the extreme, locations could even become overcrowded and counterbalance the original connectivity advantages that MNEs were looking for. As for the latter audience, our study suggests that, in their attempt to become a preferential location for specific MNE activities, cities—and, thus, city planners—should not necessarily invest simultaneously in the different dimensions of connectivity. Dispersing resources across heterogeneous forms of connectivity may in fact be a suboptimal choice, as MNEs are likely to take their location decisions based on a city's performance in the specific dimension of connectivity that is relevant for the FDI activity at stake. Thus, policymakers should concentrate their efforts on fostering specific types of connectivity, thereby targeting particular types of MNE activities.

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CONFLICT OF INTEREST

The authors declare that there is no potential conflict of interest.

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ENDNOTES

[1] We are grateful to an anonymous reviewer for this insight.

[2] Since *fDi Markets* does not provide any measures of FDI stock, we use the first 5 years of data covered by fDi Markets (2003–2008) to build various measures of the cumulated number of investments, which are used as proxies of agglomeration economies.

[3] fDi Markets has two labels for projects that are associated with R&D activities: "R&D" and "Design, Development and Testing." While the latter is meant to capture more applied R&D and the former more basic and fundamental research, a casual inspection of the project descriptions reveals that this difference is not so marked in practice. Following a widespread practice, we consider as R&D investments as both those in "R&D" and "Design, Development and Testing."

[4] We use the term "operations" to identify MNE activities in manufacturing, logistics, and supply chain. This definition is consistent with the management of operations literature (e.g., Schmenner & Swink, 1998).

[5] This is mainly due to the measure of business passengers, which is collected on a 10% sample of all airline tickets reporting carriers.

[6] The choice of the time period is dictated by the drop in geo-referenced patents from 2003 onwards.

[7] Due to data constraints, some explanatory variables are time invariant and measured at some point in time, always before 2004, which is the year when we start observing MNE investment decisions.

[8] We also estimate our baseline specifications using a Mixed Logit Model. The results, available from the authors upon request, are in line with Table 2. The most relevant difference is that in the case of HQs, the effect of the share of international passengers, although still positive, is measured quite imprecisely. Though, the effect of the share of business passengers is confirmed in magnitude and significance.

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